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Impact of Malaria Parasitemia on Some Liver Enzymes among Adults Patients Attending University of Maiduguri Teaching Hospital, Maiduguri, Borno State-Nigeria

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ABSTRACT

Nearly half of the world's population is susceptible to malaria, a potentially fatal disease. When the parasite infection is left untreated or treated incorrectly, it can lead to catastrophic side effects such as chronic renal disease, liver illness, and even death. The goal of this study was to examine the blood and liver enzymes of UMTH, Maiduguri's malaria patients. The ALP, AST, and ALT of the malaria parasite were measured using conventional techniques. In this study, 125 malaria patients at the UMTH were divided into groups according to their sex, age, gender, and malaria density. Their ALP, AST, and ALT blood liver enzyme levels were examined and compared to those of 125 control patients. The research found that the majority of malaria patients Thirty-eight (30.4%) of the malaria patients, or (58.4 percent) of the total population, were males and were between the ages of 25 and 31. They predominantly have low malaria densities (+). The mean ALP, AST, and ALT values for malaria patients were 5.801, 12.760, and 20.470, respectively. This difference was extremely significant (P 0.05). Our research revealed 2.995, 2.056, and 3.594 as very significant differences in liver enzymes. The average levels of ALP, AST, and ALT in malaria patients with (+) were 7.178, 1.854, and 7.345, respectively. indicated a significant statistical difference when compared to patients with malaria who had (++) (p 0.05/0.01). In comparison to age groups 18-24 years, 25-31 years, 32-38 years, and 39-45 years, the value of liver enzymes in malaria patients showed no significant changes at 0.621U/L, 0.120U/L, and 0.496U/L, respectively. However, as previously mentioned writers have noted, that more work must be done to implement control strategies and eradicate malaria infection in this area.

INTRODUCTION

In the tropics, malaria is a potentially fatal illness that affects approximately 400 million people, with an annual estimated fatality rate of 10,000 women of reproductive age and more than one million newborns and young children (Mishra et al, 2003). In 2010, the WHO projected that malaria-infected over 200 million people and caused up to 800,000 deaths worldwide, with more than 90% of these deaths occurring in sub-Saharan Africa.

Severe malaria can advance very quickly and result in death within hours or days.

(Trumpuz, et al., 2003).

Severe Plasmodium falciparum infections have been linked to hepatic damage, which has been linked to jaundice and elevated blood levels of liver enzymes. In the patients' liver biopsies, hepatocyte necrosis has been seen. (Kochar et al., 2003).

More than 300 million instances of malaria are identified each year, and more than 1.5 million people in sub-Saharan Africa pass away from the disease (WHO, 2012). Young children and expectant women are more susceptible to the infection's effects.

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The risk of malaria parasitemia might be very high in a setting like ours, where pesticide treatment net compliance is low and drainage systems are poorly managed. This investigation will look at how liver enzymes and electrolytes are affected by parasite levels in the malarial parasite.

LITERATURE REVIEW

The female Anopheles mosquito's bite is the primary method of naturally spreading malaria. A tiny amount of blood, which carries malaria parasites, is obtained when a mosquito bites an infected individual. These grow inside the mosquito, and about a week later, when the mosquito eats blood again, the parasites are transferred to the victim via the mosquito's saliva. The malaria parasites begin to multiply among red blood cells after a period of two weeks to many months (and perhaps years) spent in the liver, leading to symptoms including fever and headache. In severe situations, the illness worsens and results in coma, death, and hallucinations. (WHO, 2011*).*

Malarial hepatitis is characterized by elevated levels of the transaminases aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase, as well as hyperbilirubinemia with elevated conjugated bilirubin. It can lead to renal failure, anemia, or other consequences as part of the severe falciparum infection. Patients with falciparum malaria may have moderate jaundice, which can occur in 20–40% of cases of malaria, as well as a history of the yellowish coloring of the eyes and urine. Severe P. falciparum malaria is characterized by more severe jaundice and blood bilirubin levels greater than 3 mg/l. Because of hepatic destruction and impaired local microcirculation, severe falciparum malaria results in liver involvement. (Devarbhavi, et al., 2005).

Along with a huge and hard spleen, patients with malaria who have experienced multiple bouts also experience considerable liver enlargement. However, in these cases, the liver does not function abnormally. Although it hasn't been conclusively shown that malaria causes liver cirrhosis, changes in liver function have reportedly been linked to the severity of parasitemia, fever, length of sickness, nutritional status, or other underlying medical conditions. This disorder has been referred to as malaria hepatitis. (Ghoda, 2002).

AST and ALT

Transaminases are two clinically significant enzymes that are closely connected, especially in the evaluation of liver function. Aspartate aminotransferase (AST), one of the two, is known to exist in two electrophoretic ally different forms: a cationic isoenzyme linked to the mitochondria and an anionic form linked to the cytoplasm. (Calbreath et al., 1992). The liver and heart have the greatest tissue AST concentrations. With lesser concentrations in the pancreas, spleen, and lung, significant amounts are also present in skeletal muscle and the kidney. A little amount of AST is also present in erythrocytes. Different organs and tissues, including the liver, heart, skeletal muscle, kidney, pancreas, spleen, lung, and red blood cells, contain alanine aminotransferase (ALT) in various amounts. (Sherman et al., 2004). Both enzymes are sensitive indicators of liver-cell destruction since they are increased in numerous diseases associated with liver damage. (Pratt and Kaplan, 2000). For instance, before any clinical symptoms of the disease appear, patients with viral hepatitis usually present with substantial elevations in the serum activity of both ALT and AST. (Schiff et al., 1999). In many livers necro-inflammatory situations, ALT is higher than AST, indicating that it is a more accurate indicator of liver illness. (Rosenthal and Haight, 1989).

METHODOLOGY

The University of Maiduguri Teaching Hospital (UMTH), located in Maiduguri, Borno State, Nigeria, conducted the study. To service the requirements of the entire Northeast, the UMTH acts as a referral center. The city of Maiduguri is situated at latitude 11o51N and longitude 13o09E, at a height of 305m, and receives 650mm of rainfall annually. According to the 2006 census, it is home to 908,645 people and is located in the Sudan-Sahelian region, where malaria transmission exhibits pronounced seasonal variation. (Ross et al., 2010).

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Ethical clearance
The University of Maiduguri Teaching Hospital's ethics and research committee granted authorization for the study to be conducted to uphold ethical standards.

Subjects
One hundred twenty-five (125) patients with malaria symptoms who had the parasite in their blood confirmed were included in the study group (parasitemia). These patients came from the outpatient department and were sent to the hospital's parasitology lab for an examination of the malaria parasite. One hundred twenty-five (125) people without malaria made up the control group.

Inclusion Criteria
By using a Giemsa-stained thick blood film microscope, all of the test individuals' malaria parasitemia levels were determined to be positive.

Exclusion Criteria
Subjects with a history of hepatitis or renal impairment were also excluded from the trial, as were those who presented with malaria symptoms but tested negative for parasitemia or thick blood film. Subjects with abnormal liver enzyme levels were not included in the study's control group.

Sample Collection and Preparation
For sample collection, two types of bottles were used: ordinary bottles and anticoagulant bottles containing K2 EDTA. Either the anticoagulated blood sample or the drop that was still on the needle after sample collection was used to create thick blood films for the measurement of the malaria parasite. Clean venipuncture was used to draw blood samples (3–5ml) from the antecubital fossa into pre-labeled vials without placing undue pressure on the patient's arm or the syringe plunger. After allowing the samples in the plain tubes to coagulate, they were centrifuged at Obtaining the sera for the biochemical investigation required 4000rpm for 5 minutes. Separating the serum supernatants into sterile bottles allowed for quick analysis. The samples were kept in the fridge and analyzed within four (4) days if the fast analysis was not possible. (Ananad et al., 1992).

Parasitological Examination
Giemsa-stained thick films were used to identify the presence and relative parasite count of Plasmodium falciparum in each blood sample after staining for 30 minutes. When 100 high power fields (at 1000 x magnification) have been carefully investigated and no parasites have been discovered, the slide is rated as negative.

Estimation of Serum AST and ALT
Utilizing a colorimetric method called dinitrophenyl hydrazine coupling, AST and ALT were calculated. (Reitman and Frankel, 1957).

AspartateaminoTranferase (AST)
Procedure
1. 0.5ml of AST reagent 1 was dispensed into clean test tubes placed on a rack and put in a water bath set at 370C.
2. 100 ml of distilled water was poured into the test tube with the label "blank," and 100 ml of test serum was poured into the test tubes with the label's "controls" on them.
3. After carefully combining the contents of the test tubes, they were incubated in a water bath for 30 minutes.
4. Each test tube received 0.5ml of the AST reagent ll (2-4dinitrophenyl hydrazine), which was then incubated at 250C for 20 minutes.
5. To halt the reaction, 5.0 ml of sodium hydroxide (a color developer) was pipetted into the test tubes.
6. After 5 minutes, it was combined and read at 546 nm against the reagent blank.
7. The manufacturers' table was used to determine the concentration.

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Alanine aminotransferase (ALT)

Procedure

1. 0.5ml of ALT reagent I was dispensed into clean test tubes placed on a rack and put in a water bath set at 370C.
2. 100 ml of distilled water was poured into the test tube with the label "blank," and 100 ml of test serum was poured into the test tubes with the label's "controls" on them.
3. In the test tube marked "blank," 100 ml of distilled water was added, and 100 ml of test serum was added to the test tubes marked "controls."
4. Each test tube received 0.5ml of the ALT reagent ll (2-4dinitrophenyl hydrazine), which was then incubated at 250C for 20 minutes.
5. To halt the reaction, 5.0 ml of sodium hydroxide (a color developer) was pipetted into the test tubes.
6. After 5 minutes, it was combined and read at 546 nm against the reagent blank.

The manufacturers' table was used to determine the concentration.

Data Analysis

Using the statistical tool IBM SPSS Statistics version 20.0 software, descriptive statistics were applied to the study's data. The treatment means throughout the study's age groups were described using the mean and standard deviation. Additionally, frequencies were employed to display the outcome. The student t-test and analysis of variance (ANOVA) for several groups were used for statistical comparison. The data were presented using frequencies as well. The results were deemed significant when the p-value was 0.05 or greater.

RESULTS

In this study, 125 malaria patients from the University of Maiduguri Teaching Hospital in Nigeria and 125 non-malaria control participants, including students, hospital employees, and university personnel, were enrolled.

The sociodemographic details of malaria patients at the University of Maiduguri Teaching Hospital in Nigeria and control individuals are shown in Table 4.1. The gender and number of the study participants and the control individuals were mismatched. Males made up 70.4 percent (7.4%) of the malaria patients and 48 percent (48%) of the control participants, respectively. The majority of malaria patients (40%) and control individuals (44%), however, are between the ages of 25 and 31 years, whereas only 8.0 and 12.8%, respectively, are between the ages of 39 and 47 years. Out of 125 patients with malaria, 111 (88.8%) have a malaria density of (+), and 14 (11.2%) have a malaria density of (++).

The electrolyte and liver enzyme mean values of malaria patients at the University of Maiduguri Teaching Hospital in Nigeria and control subjects are shown in Table 4.2. In comparison to control volunteers, malaria patients' mean sodium levels (2.074) differed considerably (p 0.05). There was no statistically significant difference between the mean values of K+, CL, HCO3-, ALP, AST, and ALT in malaria patients and controls (p 0.05).

The mean electrolyte and liver enzyme levels of malaria patients at the University of Maiduguri Teaching Hospital in Nigeria are listed in Table 4.3 by gender. Male malaria patients' mean values for Na+, K+, and ALT were substantially different from female malaria patients' (p 0.05/0.01) (1.970, 2.020, and 4.962, respectively). Male malaria patients' mean values for Cl-, HCO3-, ALP, and AST did not differ statistically from those of the female individuals (p 0.05/0.01).

According to density, Table 4.4 displays the average values for electrolytes and liver enzymes in malaria patients at the University of Maiduguri Teaching Hospital in Nigeria. The mean value of ALP (7.076) with + malaria patients indicated a statistically significant difference from that of ++

malaria patients. However, there was no statistically significant difference between the mean levels of Na+, K+, Cl-, AST, and ALT in patients with malaria who had + (p 0.0/0.01).

According to age group, Table 4.5 displays the average electrolyte and liver enzyme levels of malaria patients at the University of Maiduguri Teaching Hospital in Nigeria. There was no statistically significant difference between the mean values of Na+, K+, Cl-, HCO3-, ALP, AST, and ALT when compared to the age groups of 18–24 years, 25–31 years, 32–38 years, and 39–47 years, respectively (p 0.05).

Table 4.1: Socio-demographic characteristics of malaria patients in University of Maiduguri Teaching Hospital, Nigeria, and Control subjects

Variables	Malaria Patients		Control Subjects	
	Frequency (N)	Prevalence (%)	Frequency (N)	Prevalence (%)
Gender				
Female	37	29.6	65	52.0
Male	88	70.4	60	48.0
Total	**125**	**100.0**	**125**	**100.0**
Age Group (years)				
18-24	37	29.6	32	25.6
25-31	50	40.0	55	44.0
32-38	28	22.4	22	17.6
≥ 39	10	8.0	16	12.8
Total	**125**	**100.0**	**125**	**100.0**
Malaria Density				
(+)	111	88.8	-	-
(++)	14	11.2	-	-
Total	**125**	**100.0**	**-**	**-**

Keys: + = Malaria density of 1-10 malaria parasites per high power field and ++ = Malaria density of 11-100 malaria parasites per high power field.

Table 4.2: Mean Values of El Liver Enzymes of Malaria Patients in University of Maiduguri Teaching Hospital, Nigeria and Control Subjects.

Variables	Malaria Patients (N = 125)	Control Subjects (N = 125)	t value (P = 0.05/0.01)
ALP (U/L)	36.38 ± 13.06	39.80 ± 14.68	$1.858^{N.S}$
AST (U/L)	14.61 ± 9.62	14.12 ± 11.66	$0.358^{N.S}$
ALT (U/L)	10.16 ± 4.64	10.34 ± 5.15	$0.305^{N.S}$

Keys: ALP = Alkaline phosphatase, AST = Aspartate transaminase, ALT = Alanine transaminase, SD = Standard deviation, N = frequency, * = statistically significant (P ≤ 0.05), N.S = not significant.

Table 4.3: Mean Values of Liver Enzymes of Malaria Patients in University of Maiduguri Teaching Hospital, Nigeria concerning Gender.

Variables	Female Malaria Patients (N = 37)	Male Malaria Patients (N = 88)	value (P =0.05/0.01)
	Mean ± SD	Mean ± SD	
ALP (U/L)	38.24 ± 14.89	35.60 ± 12.22	$1.065^{N.S}$
AST (U/L)	15.25 ± 8.30	14.34 ± 10.56	$0.228^{N.S}$
ALT (U/L)	8.76 ± 4.17	10.75 ± 4.72	4.962**

Keys: ALP = Alkaline phosphatase, AST = Aspartate transaminase, ALT = Alanine transaminase, SD = Standard deviation, N = frequency; * = statistically significant (P ≤ 0.05)** statistically significant (P≤ 0.01),N.S = not significant.

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Table 4.4: Mean Values of Liver Enzymes of Malaria Patients in University of Maiduguri Teaching Hospital, Nigeria about Malaria Density.

Variables	Malaria Patients with (+) (N = 111)	Malaria Patients with (++) (N = 14)	t value (P =0.05/0.01)
	Mean ± SD	Mean ± SD	
ALP (U/L)	35.31 ± 11.64	44.93 ± 19.84	7.076**
AST (U/L)	14.46 ± 9.38	15.79 ± 11.70	0.235^{NS}
ALT (U/L)	10.34 ± 4.54	8.71 ± 5.36	1.538^{NS}

Keys: ALP = Alkaline phosphatase, AST = Aspartate transaminase, ALT = Alanine transaminase, SD = Standard deviation, N = frequency, + = Malaria density of 1-10 malaria parasites per high power field and ++ = Malaria density of 11-100 malaria parasites per high power field; ** = statistically significant p-value ≤ 0.01, N.S not Significant.

Table 4.5: Mean Values of Liver Enzymes of Malaria Patients in Maiduguri, Nigeria concerning Age Group.

Variables	18-24 years (N = 37)	25-31 years (N = 50)	32-38 years (N = 28)	≥ 39-47years (N = 10)	F value (P=0.05/0.01)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
ALP (U/L)	38.59 ± 16.38	35.96 ± 11.04	35.36 ± 13.24	33.20 ± 7.25	0.621
AST (U/L)	15.08 ± 14.11	14.26 ± 6.89	15.04 ± 8.04	13.40 ± 4.84	0.120
ALT (U/L)	10.03 ± 5.63	10.54 ± 4.99	10.21 ± 2.50	8.60 ± 3.47	0.494

Keys: ALP = Alkaline phosphatase, AST = Aspartate transaminase, ALT = Alanine transaminase, SD = Standard deviation, N = frequency; p-value ≤ 0.05 = statistically significant and p-value >0.05 is not statistically significant.

DISCUSSION

In this study, the blood and liver enzymes (ALP, AST, and ALT) of 175 control subjects and 175 malaria patients at the UMTH were compared. The patients were divided into groups based on sex, age, and malaria density. According to our research, men made up the majority of malaria patients (70%) and the majority of them (39.5%) were between the ages of 21 and 35. They predominantly have low malaria densities (+). The results of this investigation are congruent with those of prior, in-depth studies. (Kotepui *et al*., 2015). This might be because more of the people in the group visited the hospital.

In this investigation, the ALP, AST, and ALT levels of the blood and liver enzymes (control individuals) and malaria patients were compared.

According to our research, there were no appreciable differences between the control participants' and malaria patients' mean values for the liver enzymes ALP, AST, and ALT, with p-values of 0.292, 0.848, and 0.559 respectively. This result is in contrast to earlier studies by Onyesom et al. (2011), which demonstrated significantly different levels of ALP, AST, and ALT in malaria infection. But this research found that male malaria patients had much higher ALT concentrations. patients when compared to the malaria patients who were female (p-value = 0.035). This is consistent with earlier research (Onyesom et al., 2012). The study also showed that there were no gender-related differences in malaria patients' ALP and AST concentrations that were statistically significant (p-value 0.05). The results of the current investigation also demonstrated that the liver enzymes of malaria patients were not significantly affected by malaria density. Coker et al. (2003) AST and ALT values were seen to increase linearly with rising bilirubin levels in patients with malaria hepatitis. Contrary to our data, other research has also shown that liver impairment occurs in Plasmodium falciparum malaria patients. (Anad *et al*., 1992; Premaratne *et al*., 2001). The leakage from hepatic cells that were killed or damaged by the auto-immune process as well as aberrant cell activation brought on by the parasites could both contribute to an elevation in liver enzyme (ALT) levels. (Jarike *et* al., 2002).

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This finding backs up the earlier study. (Ogbadoyi *et al*., 2009) According to the alterations in liver function indicators, P. falciparum malaria patients tend to have some liver dysfunction and compromise, with male patients, regardless of age, appearing to have more severe liver dysfunction and compromise.

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